

# Internal Properties of Lakes

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Integrated Lakes Management

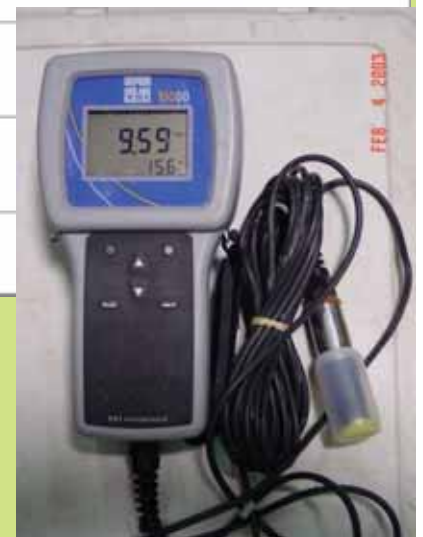
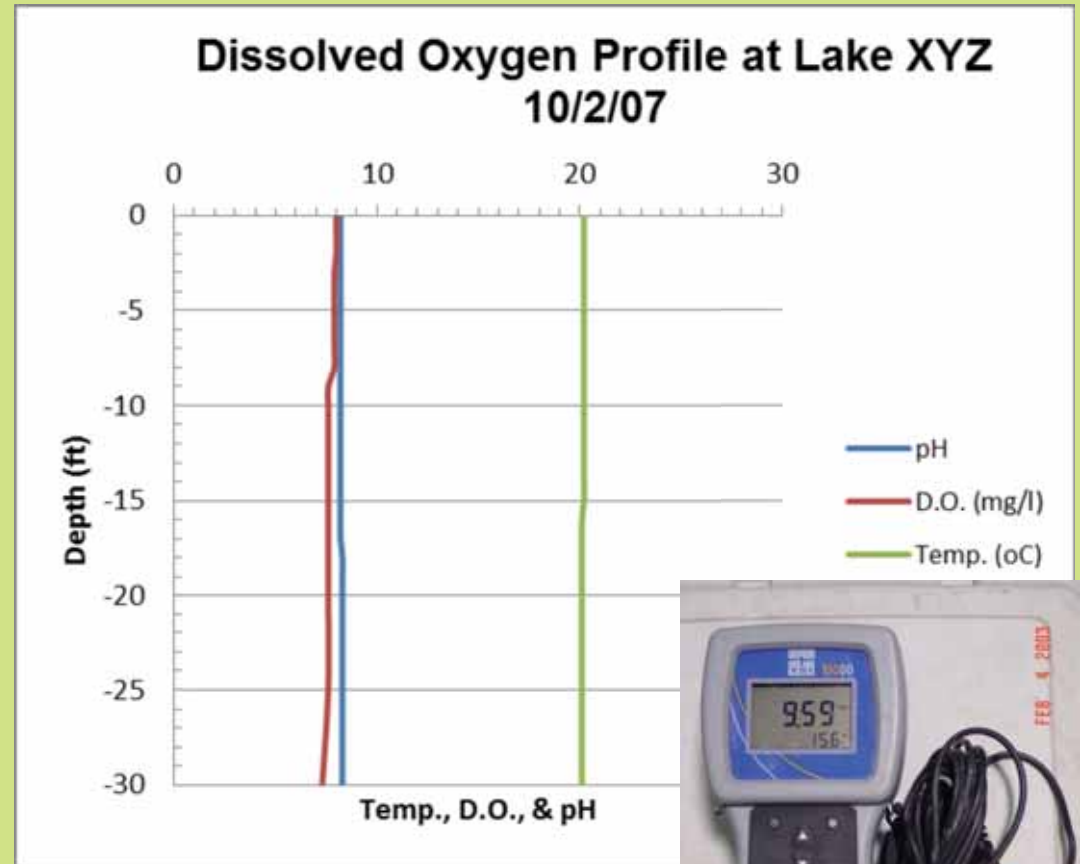


# Topics

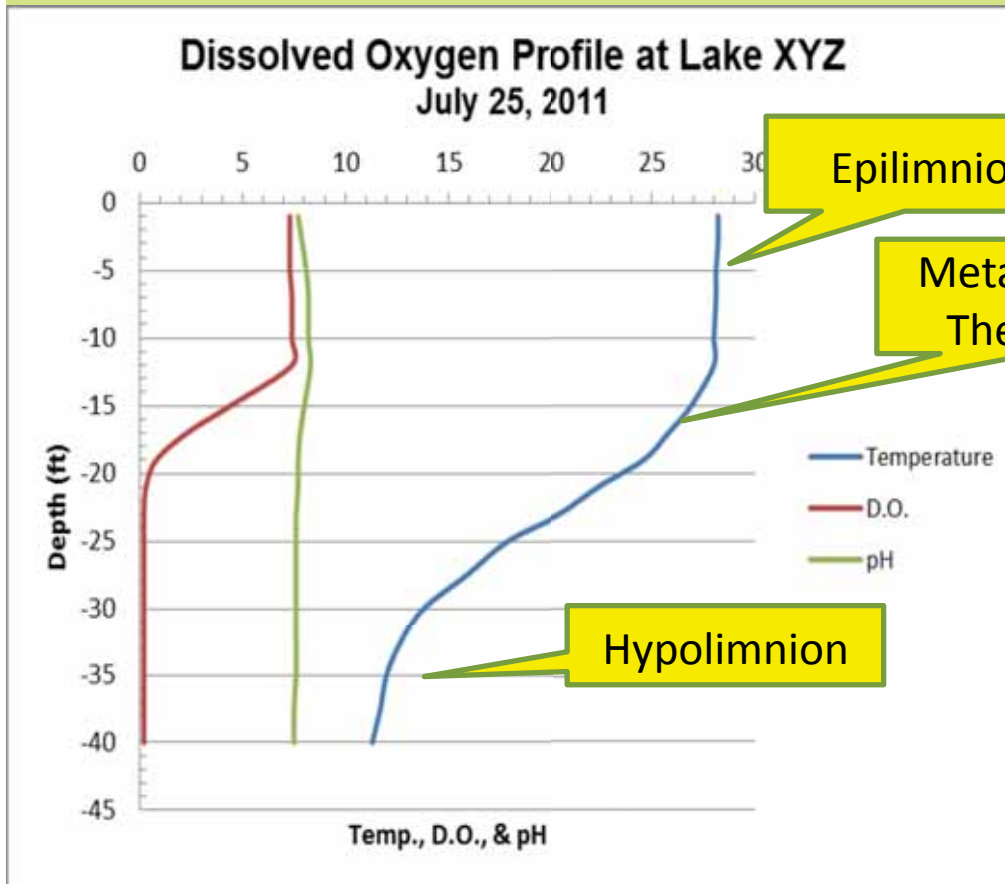
- Stratification
  - Mixing
  - Water clarity
- Dissolved oxygen

# Thermal Stratification

- Typical spring & fall conditions – well mixed lake
- Oxygen and temperature the same throughout depth



# Thermal Stratification

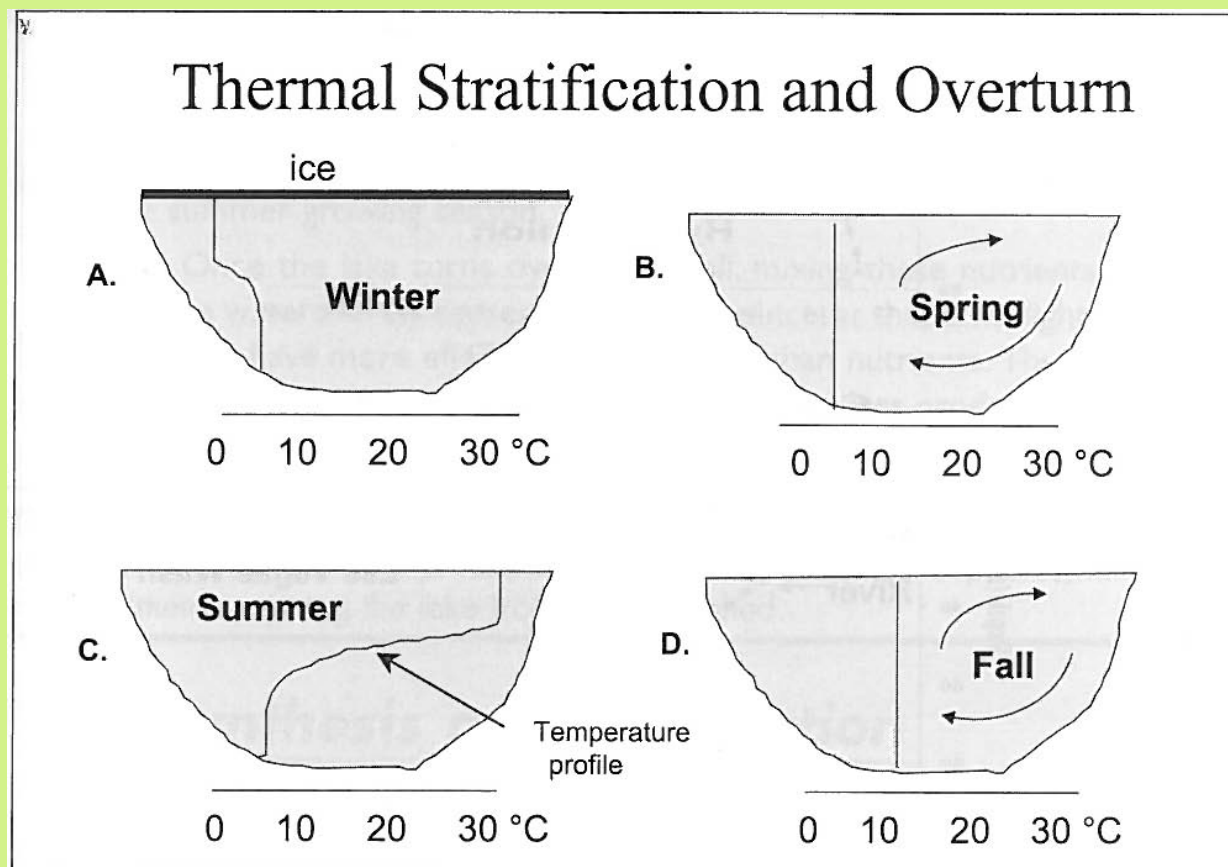


## Summer Conditions

- Epilimnion - high oxygen levels, warm water
- Thermocline – zone of rapidly changing temperature and density
- Hypolimnion – low oxygen, cooler water

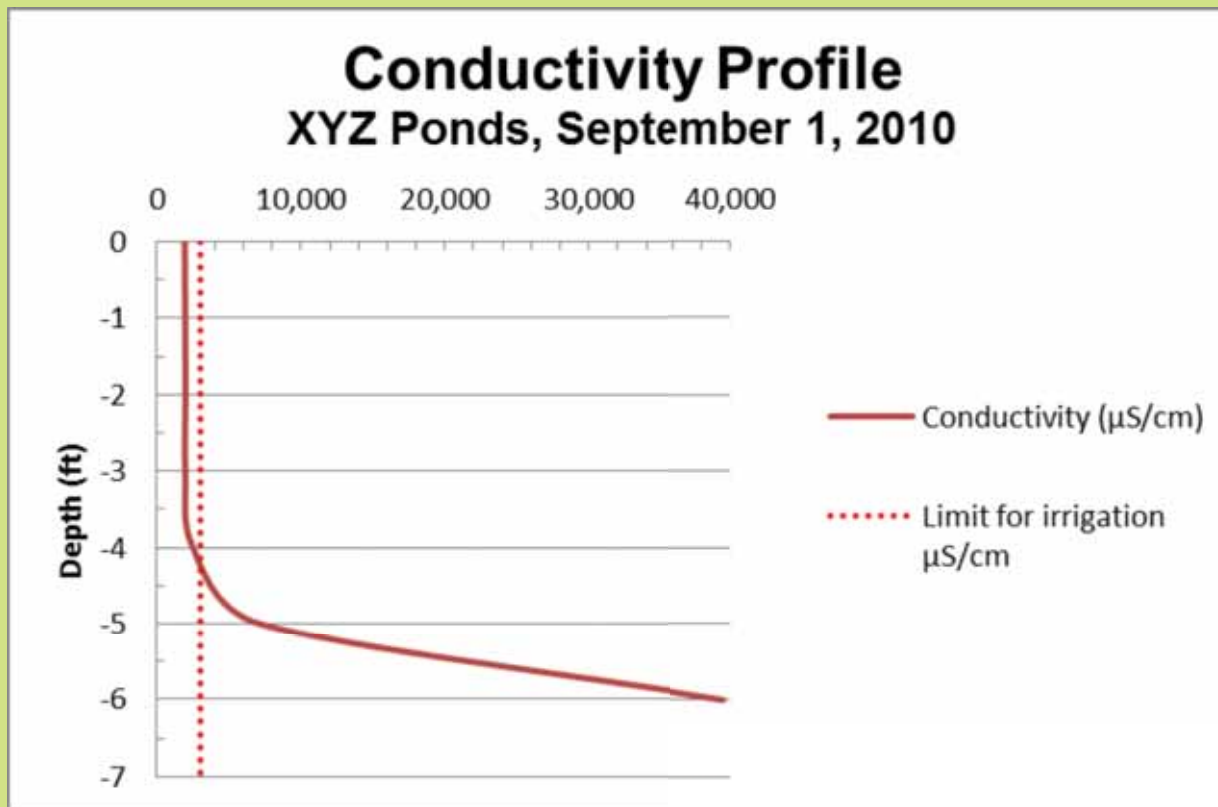
# Stratification & Mixing

- Dimictic Lakes - stratified in summer and winter and mixed in spring & fall
- Polymictic Lakes – shallow lakes with little or infrequent stratification



From *Managing Lakes & Reservoirs*, 3<sup>rd</sup> ed.  
NALMS & USEPA, 2001

# Salinity Stratification

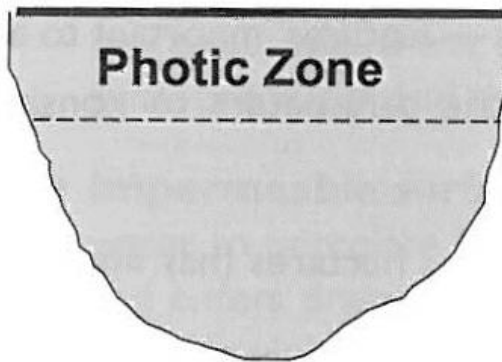


- Salt water is much heavier than fresh water
- Road salt inflows is a problem

# Water Depth

## Lake Depth and Productivity

### Deep Lake



- Small % of lake volume is in photic zone.
- Greater mean depth

### Shallow Lake



Limit of light penetration

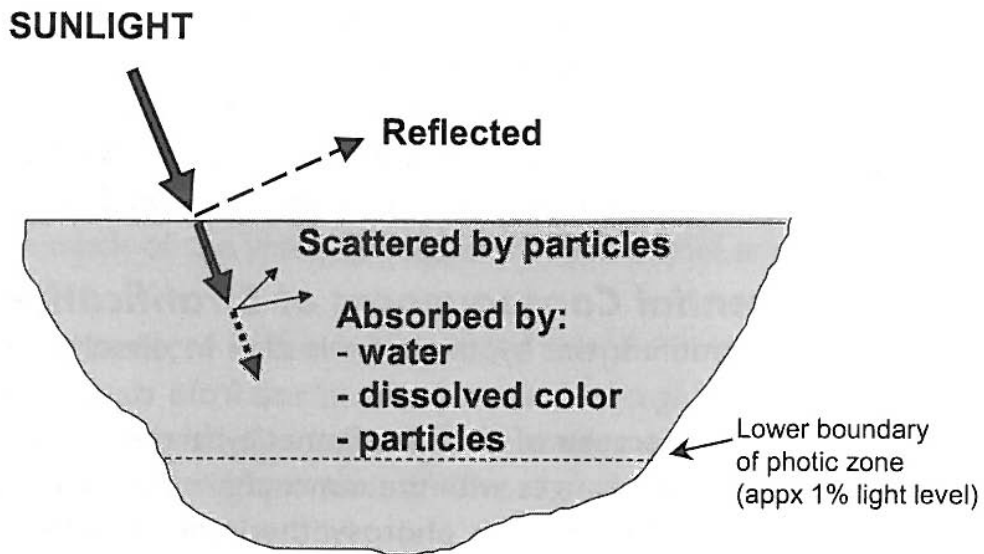
- Most of lake volume is in photic zone
- Smaller mean depth





# Water Clarity

## Light Attenuation



## Secchi Disk



# Water clarity influences

**Suspended sediment**



**Planktonic algae**



# Water Clarity Influences

Use of dyes

Dense growth of  
Filamentous Algae



# Plant Dominated Lakes vs. Algae Dominated Lakes

Clear water – macrophyte  
dominated lakes

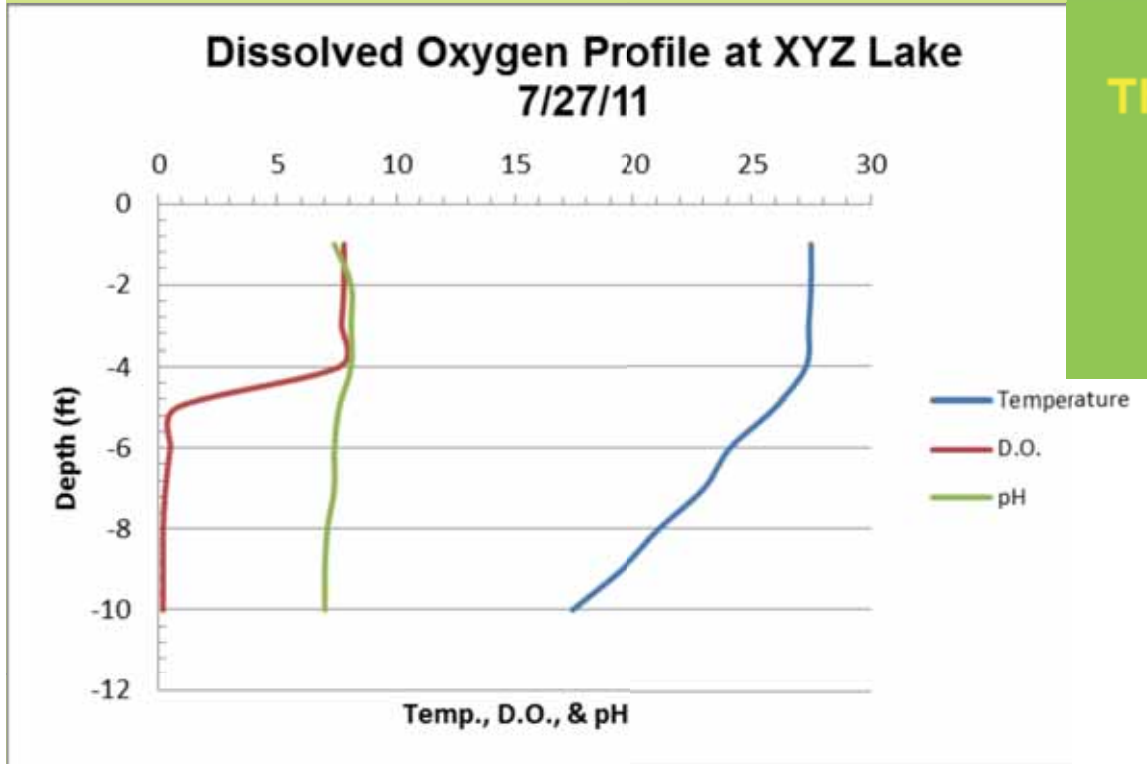


Turbid water – algae  
dominated lakes



# Dissolved Oxygen

Low oxygen can cause fish kills  
- IEPA Standard is 5 mg/l



## Dissolved Oxygen

### Threshold Levels

75%  
Saturation

GOOD

8 mg/L (trout)

5 mg/L

POOR

3 mg/L

BAD

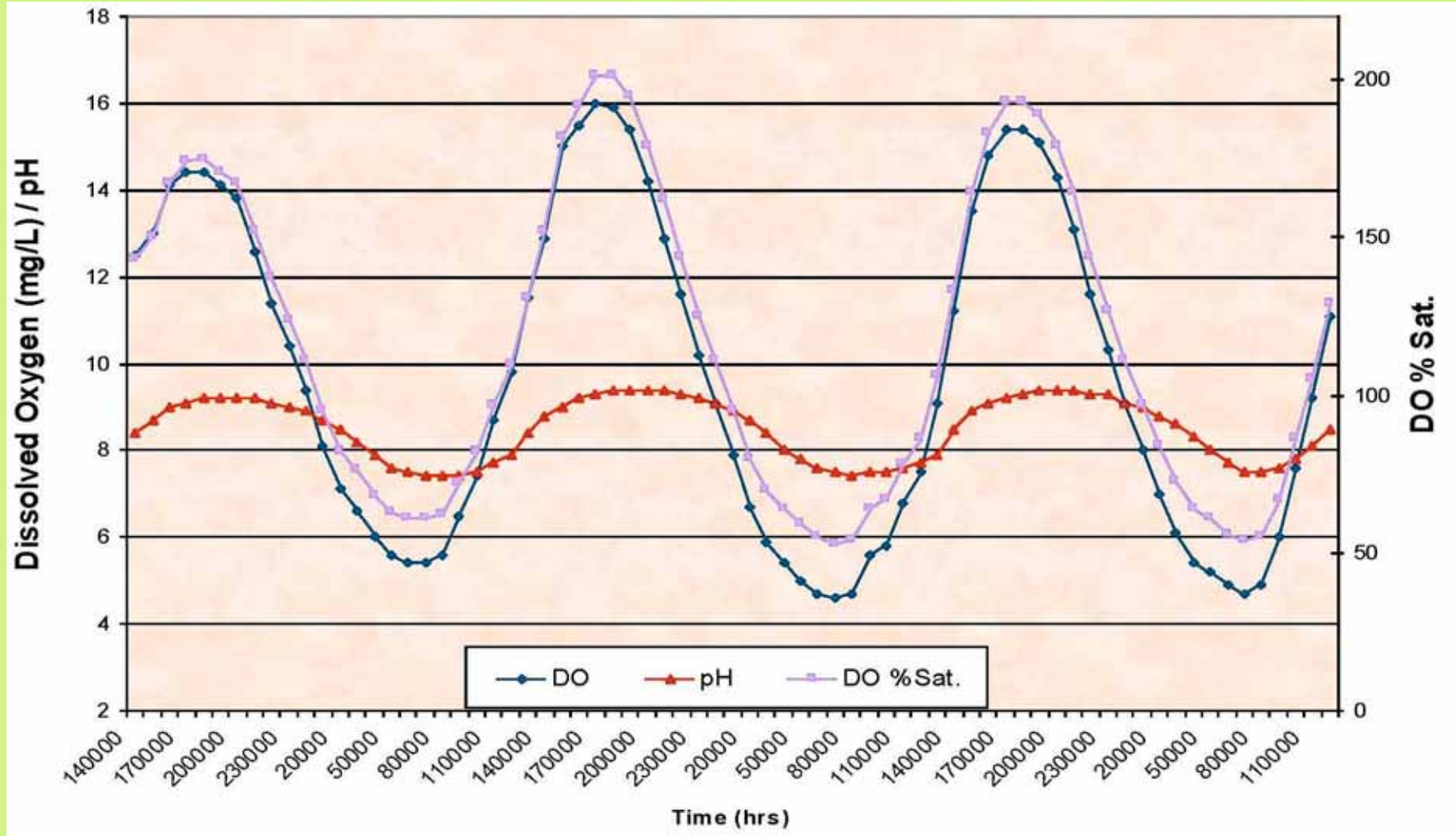
Hypoxia

Anoxia



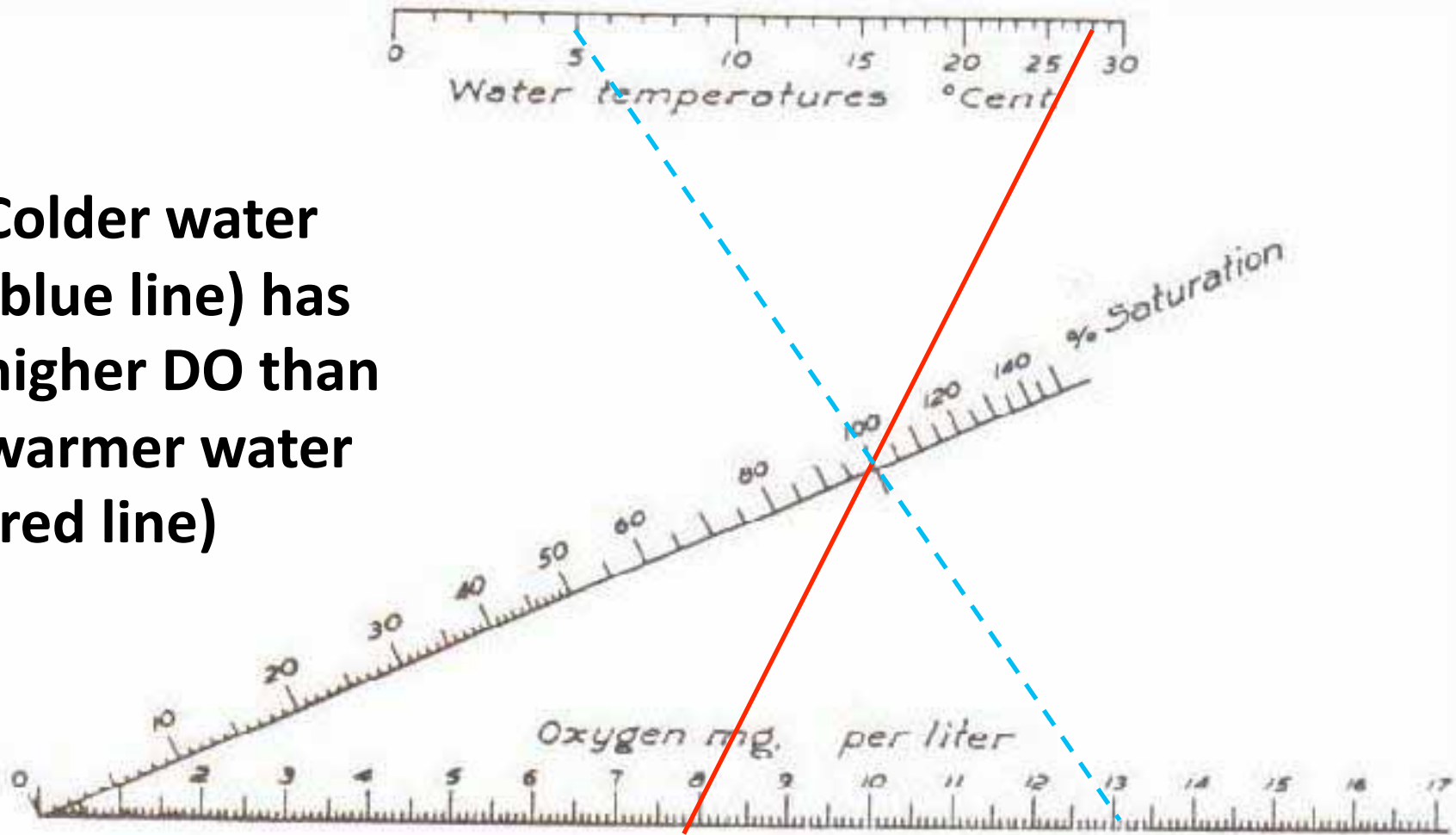


# Dissolved Oxygen has Diurnal Changes

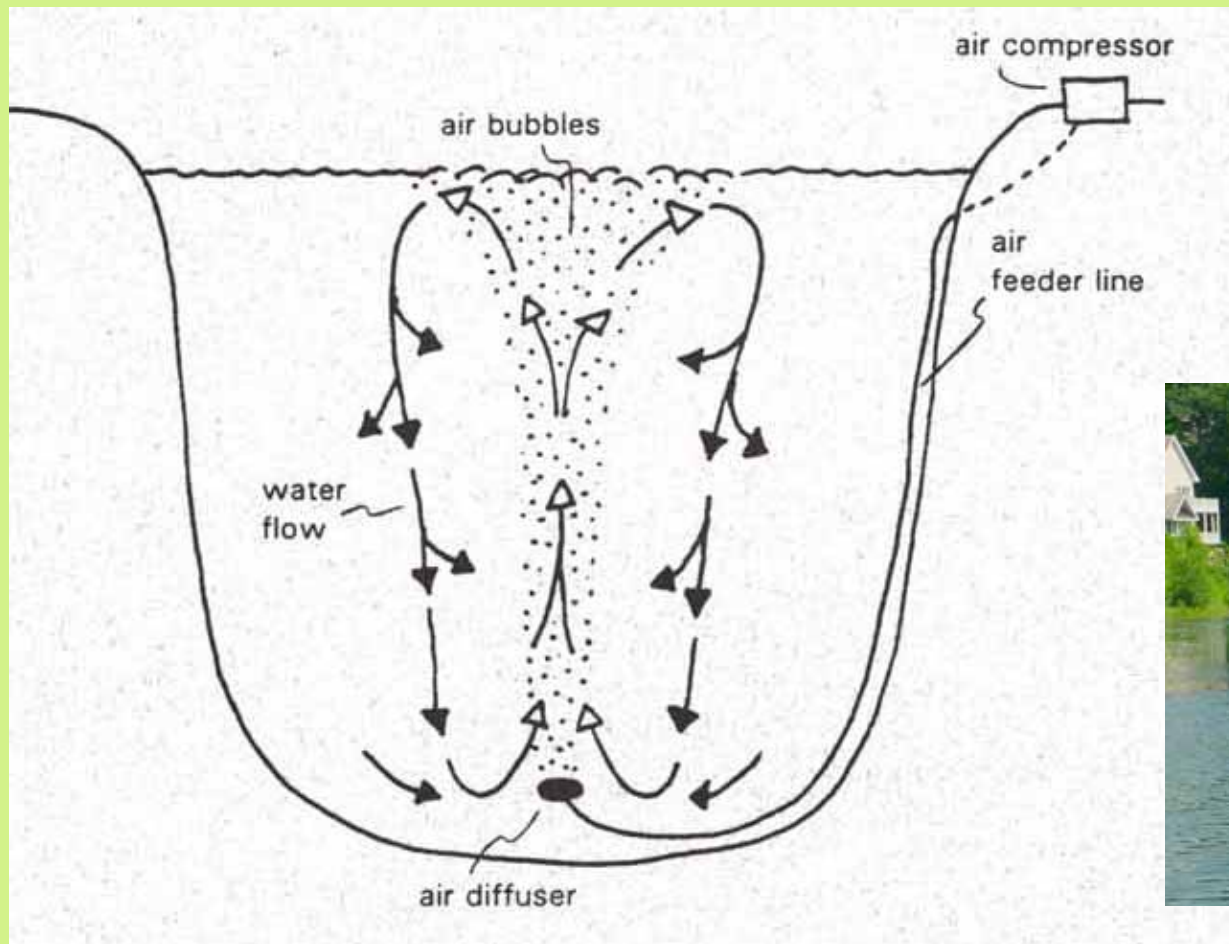


# Oxygen Saturation Changes with Water Temperature

**Colder water  
(blue line) has  
higher DO than  
warmer water  
(red line)**



# Aeration Changes D.O. and Stratification





# Summary

- Internal Properties of Lakes can make each lake unique.
  - Lakes typically stratify in summer
  - Lakes can be dominated by aquatic plants or algae
  - Water clarity is influenced by algae, aquatic plants, and suspended sediments
  - Dissolved oxygen varies depending on depth, time of day and water temperature
    - Aeration can alter dissolved oxygen and stratification